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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/810,719	03/29/2004	Panayotis C. Andricacos	YOR920000395US2	8916
30678	7590	03/20/2006	EXAMINER	
CONNOLLY BOVE LODGE & HUTZ LLP			ZARNEKE, DAVID A	
SUITE 800				
1990 M STREET NW			ART UNIT	
WASHINGTON, DC 20036-3425			2891	
			PAPER NUMBER	

DATE MAILED: 03/20/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/810,719	ANDRICACOS ET AL.	
	Examiner	Art Unit	
	David A. Zarneke	2891	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 March 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 20-22 and 25-42 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 20-22 and 25-42 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 29 March 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>7/22/04</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 20-42 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-27 of U.S. Patent No. 6,946,716.

Although the conflicting claims are not identical, they are not patentably distinct from each other because the only differences are the aspect ratio and the width of the openings, the use of a seed layer, and the use of an additive in the bath. These differences do not patentably distinguish these claims from the patent because the aspect ratio and the width of the openings would be obvious to optimize, the use of a seed layer in the opening and an additive in the bath are both conventionally known in the art steps used in filling an opening.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Andricacos et al., US Patent 6,331,237.

Andricacos (1, 38+) teaches a copper damascene structure which comprises:

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a substrate having a dielectric layer having a via and/or line opening therein;
the via and/or line opening having a liner or barrier layer on sidewalls and bottom surfaces of the via opening;
a metal seed layer on the liner or barrier layer; and
wherein the via and/or line opening is filled with electroplated copper that forms a continuous interface with the liner or barrier layer and being substantially free of internal seams or voids (3, 14-18; 3, 49-54; 4, 21-24; 4, 32-34;).

While Andricacos fails to teach the damascene structure having an aspect ratio of greater than about 3 and a width of less than about 0.275 μm , it would have been obvious to one ordinary skill in the art at the time of the invention to optimize the aspect ratio and width of the damascene structure, particularly in light of Andricacos' teaching of the usefulness of electroplating in high aspect ratio applications (MPEP 2144.05).

Claims 21-42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Andricacos et al., US Patent 6,331,237, in view of Landau, US Patent 6,261,433.

Andricacos teaches an interconnect structure obtained by the process which comprises:

forming an insulating material on a substrate;
lithographically defining and forming recesses for lines and/or vias in the insulating material in which interconnection conductor material will be deposited;
depositing a barrier layer against copper diffusion;
depositing a current carrying copper seed layer; and
depositing the copper conductor by electroplating from a bath.

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Andricacos fails to teach the bath contains a dissolved cupric salt wherein the concentration of the cupric salt is at least about 0.4 molar and an acid and wherein the bath has an acidic pH.

Landau teaches a plating solution containing a dissolved cupric salt (18, 17+) wherein the concentration of the cupric salt is at least about 0.4 molar [0.8-1.2M (17, 51+) overlaps the claimed range) and an acid and wherein the bath has an acidic pH (18, 12+).

It would have been obvious to one of ordinary skill in the art at the time of the invention to use the plating bath of Landau in the invention of Andricacos because Landau teaches this bath provides a uniform and void-free deposition of metal (abstract).

Regarding claim 25, Landau teaches the cupric salt concentration is 0.8-1.2M (17, 51+), which overlaps the claimed range of 0.8M.

With respect to claim 26, Landau teaches the cupric salt is CuSO_4 (18, 17+).

As to claims 27 and 28, Landau teaches the acid concentration is 0-0.2M, which overlaps the claimed ranges.

In re claim 29, Landau teaches the acid is sulfuric acid (18, 14+).

Regarding claims 30 and 31, it would have been obvious to one ordinary skill in the art at the time of the invention to optimize the bath pH (MPEP 2144.05), particularly in light of Landau's teaching that the bath low or no acid concentrations (18, 12+).

With respect to claims 32 and 33, Landau teaches the use of various additives (18, 30+) and does not list complexing agents as a possible additive.

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As to claim 34, Landau teaches electroplating a metal such as copper onto a semiconductor wafer. Landau recognizes that the metal seed layer is susceptible to dissolution in the electrolyte. One cause is the exchange current density of the electrolyte which is about 1 mA/cm² for copper. To minimize the risk of the seed layer being dissolved in the electrolyte, a voltage is applied to the substrate before the substrate is introduced into the electrolyte (17, 10-23).

With respect to claim 35, Landau teaches the use of a relatively low current density is applied during the initial plating because the resistive substrate effect is dominant during the beginning of the plating cycle (16, 32+).

In re claim 36, while Landau fails to teach how long the initial current density is maintained, it would have been obvious to one ordinary skill in the art at the time of the invention to optimize the duration of the initial current density through routine experimentation (MPEP 2144.05).

As to claim 37, Landau teaches a current density of 5-100mA/cm² (4, 56-60).

In re claim 38, Andricacos teaches the barrier layer deposited on the sidewalls and bottom surface of the lines or vias, and the metal seed layer beneath the copper (1, 38+).

Regarding claim 40, Andricacos teaches the metal seed layer is copper (4, 25+).

With respect to claim 41, while Andricacos fails to teach the damascene structure having an aspect ratio of greater than about 3 and a width of less than about 0.275 μ m, it would have been obvious to one ordinary skill in the art at the time of the invention to optimize the aspect ratio and width of the damascene structure, particularly in light of

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Andricacos' teaching of the usefulness of electroplating in high aspect ratio applications (MPEP 2144.05).

As to claim 42, Andricacos teaches the copper is planarized or polished (1, 38+).

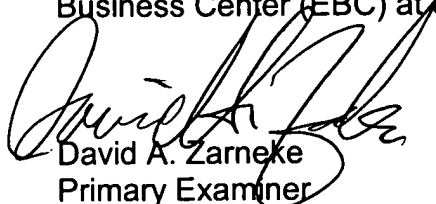
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David A. Zarneke whose telephone number is (571)-272-1937. The examiner can normally be reached on M-Th 7:30 AM-6 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, William Baumeister can be reached on (571)-272-1722. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic

Business Center (EBC) at 866-217-9197 (toll-free).


David A. Zarneke
Primary Examiner
March 15, 2006